Industrial Health

TUESDAY MORNING SESSION

October 7, 1941

Presiding—Dr. C. H. Watson, Medical Director, American Telephone & Telegraph Company, New York City, and Past-President, National Safety Council.

National Defense Brings an Improved Industrial Hygiene Program

By C. D. SELBY, M.D.

Detroit, Mich.

The World War gave us a good industrial health program—at least, the fundamentals were sound. With the strengthening that came out of the researches and more mature experiences during the interval of peace, most notably in the field of industrial hygiene engineering and toxicology, this program is proving basically adequate to the needs of the national defense emergency.

In June, 1940, Surgeon General Parran, U. S. Public Health Service, requested the appointment of a committee by the American Association of Industrial Physicians and Surgeons to advise with the Division of Industrial Hygiene of the National Institute of Health on industrial hygiene services of the national defense program.

Under the chairmanship of Dr. R. R. Sayers, this committee sensed the tremendous burden that would be put on industry by successful national defense and the consequent need of fully maintaining the health and efficiency of the workers. It recommended the creation of a coordinating agency within, or advisory to, the Division of Industrial Hygiene of the National Institute of Health, for the purpose of making available all national resources related to the maintenance of health in the defense industries.

Some of the objectives of this proposed coordinating agency were specified as follows:

1. The development of a joint approach to the problem with Federal, State and other agencies concerned with industrial health.

2. The selection of important industries for immediate medical and engineering control of existing and potential health hazards.

3. The determination of present health service facilities in industry.

4. The development of a directory of qualified personnel.

5. The training of personnel.

6. An appraisal of the fatigue statutes in relationship to the national defense program.

7. The determination of methods for the absorption of handicapped persons into vital industries for national defense.

8. To mobilize all existing laboratories for the purpose of investigating hazardous materials to be employed in industries concerned with national defense.

9. Preparation and dissemination of information on various toxic materials and processes for the practical protection of the health of the workers.

10. To investigate the problem of personnel in industrial hygiene and medicine being mobilized for services other than the above.

11. To promote measures for control of syphilis, tuberculosis, and other communicable diseases among industrial workers.

It was the sense of the committee that THERE IS A SAFE JOB FOR EVERY WORKER IN THE DEFENSE INDUSTRIES, provided we utilize the knowledge already developed in the field of industrial health.

A coordinating agency was created, the Subcommittee on Industrial Health and Medicine of the Health and Medical Committee, Federal Security Agency, with the director of the Federal Security Agency, Hon. Paul V. McNutt, as coordinator of all health, medical, welfare and related activities in relation to national defense.

The subcommittee designated the Division of Industrial Hygiene of the National Institute of Health as the appropriate Federal instrument for the administration of the program.

Under its stimulus and guidance, the move toward the creation of industrial hygiene bureaus or divisions in the health departments of the various states and important industrial centers, already under way prior to the emergency, has been greatly broadened until now there are such agencies in thirty-four states and several industrial communities. All told, there are approximately 250 professional personnel engaged in industrial hygiene in state and local health departments, with expenditures of about one million dollars a year. The Division of Industrial Hygiene, National Institue of Health, alone has a total of approximately 140 persons, with an annual budget of $500,000.

Interest Spreads

Concurrently with this activity in the Federal, State, and local levels of government, has come a considerable increase of interest in the subject of industrial health—equally evident in manufacturing, labor, medical, industrial hygiene, and nursing circles. This has been gradually growing during the past five or six years and now, under the incentive of national defense, it is spreading with amazing acceleration.

Most large industries have well organized medical departments, equipped and manned for health maintenance on an adequate basis. The Army and Navy, two large and exceedingly important employers of civilian labor, are preparing to offer the same type of service in their establishments.

The problem still remaining unsolved is in the small plants, which in the aggregate employ about two-thirds of the workers and must necessarily depend upon the general medical practitioners. It is believed that these latter can do the job, acting jointly with the industrial hygiene engineers, either through the facilities furnished by state industrial hygiene bureaus or private consultants, and aided by suitably trained nurses.

The American Medical Association saw this problem some time ago and wisely created its Council on Industrial Health.

Acting on its own behalf, and through committees in the component state and local societies, the council has done much to promote knowledge in industrial health methods and to make it available to the general medical practitioners.

There is similar activity in other professional organizations as well. Last June, the American Association of Industrial Physicians and Surgeons and the American Industrial Hygiene Association jointly ran a week of post-graduate work in connection with their annual meetings in Pittsburgh. This was well attended and proved exceedingly effective as an educational effort.

Without attempting to mention all organizations that are working in this direction, it suffices to say that the professions which are concerned with the health of the workers are concentrated on the problems of the defense industries.

It is particularly encouraging to note that this interest is not limited to the professional fields, but has the support of both management and the workers. Witness the accomplishments of the National Safety Council, the College of Surgeons and, more recently, the Committee on Healthful Working Conditions of the National Association of Manufacturers. It is also believed that the U. S. Chamber of Commerce is planning something along these lines, which promises to be of importance.

Perhaps most significant of all is the fact that labor unions are concerning themselves with the health of the workers. The interest of the individual workers is beyond question.

Interest Inspires Progress

It is seen from the foregoing that there is a sufficient background of interest in industrial health to inspire progress, and the professions are taking advantage of it to improve their program.

Occupational Diseases. The most notable advance in this direction is in the control of occupational disease. Researches in the toxic effects of the newer chemicals and materials essential in defense manufacturing are expanding. Industrial hygiene engineering methods are coming into more general use and industrial physicians are becoming better informed on conditions in their plants. The net result of this growth of industrial hygiene and toxicology is better control of occupational diseases.

Sickness Absenteeism. As a by-product of their studies of methods and procedures for the control of occupational diseases, industrial physicians have been impressed by the great amount of disability resulting from ordinary sicknesses. The Division of Industrial Hygiene of the National Institute of Health for some years has attempted to arouse interest in this aspect of industrial health and has succeeded to such a degree that studies of sickness absenteeism are now becoming a common practice in industry.

Although these have not gone far enough to show results, they do permit some tentative conclusions. The most outstanding of these are that 60 per cent of all absenteeism is due to non-occupational sicknesses and, not counting short-term disabilities, about 10 per cent of all workers lose an average of something like 40 days each year because of them. The principal sources of absenteeism of this nature are in diseases of the respiratory tract—one-third of all cases. These are preventable.

Tuberculosis. Parenthetically, it is of value to know that tuberculosis causes but a very small fraction of all disability, and this is a tribute to the effectiveness of the anti-tuberculosis program. Even though the prevention of tuberculosis is a public health function, industry is serving as a case-finding agency and, as such, is beginning to assume a very important part in the further control of that disease.

Syphilis. The campaign for the control of syphilis, initiated by Surgeon General Parran, is also showing results. Whereas formerly certain industries in the northern states had a syphilis rate of about 3 per cent, many of these are now showing a rate of only 1½ per cent.

Defense Promotes Cooperation. This campaign in particular exemplifies the importance of cooperation between the medical departments of industry, the public health departments, and the general practitioners of the communities in which industries are located. Further cooperation can be expected to come out of the national defense program. In fact, it is now realized that the only way in which results can be obtained in the reduction of sicknesses due to non-occupational causes, must be through a united effort of this nature.

Through their physical examinations, the plant physicians serve as case-finding agencies. The medical professional treats the cases. And if, by virtue of early diagnosis, researches in the field of preventive medicine, or by a little better care in the handling of cases, disabilities can be shortened by one or two days in each case, the saving in lost time will be enormous.

Immunization. It has always seemed unwise for industrial physicians arbitrarily to administer cold vaccines to large industrial groups. It has also seemed unwise for them to administer vitamins to all workers on the theory that all are undernourished. These are important medical procedures and should not be indiscriminately applied to masses. On the contrary, they should be given only according to indications in each individual case.

At the moment, industrial physicians are importuned to give the workers cold vaccines and vitamins. As these are medical treatments, I am convinced they belong in the field of private practice. However, there is no objection to putting vitamins back into food products from which they have been removed by refining processes in manufacturing. Nor is there any objection to discussing balanced diets with the workers.

Mental Hygiene. There are frequent discussions regarding mental hygiene in industry, the general assumption being that industry does nothing about it. The present seems an appropriate time to take stock and outline a program, if possible. This, the Federal Government is doing through a special Committee on Personal Relations, which sprang out of the joint action of the Neuropsychiatric Committee of the National Research Council and the Subcommittee on Industrial Health and Medicine.

The special committee has undertaken the study of the problem and is effecting suitable measures for initiating a practical mental hygiene program in industry. As indicated by its name, the committee is developing its research along lines of personal relations. With such a sound approach, I feel optimistic of the results.

All industrial physicians use mental hygiene methods to a considerable degree, either consciously or unconsciously, and in very much the same manner as does the general medical profession in the pursuit of private practice. Every patient who consults a doctor has in some degree a mental hygiene problem. Although it may be only a very minor worry, it has considerable influence upon the patient and the outcome of his ailment.

Usually, during conference between physician and patient, these worries come to the surface. If the patient has an appropriate opportunity to tell his whole story, the mere telling frequently serves to assist him in the solution. So one of the important functions of the doctors in industry is to listen sympathetically to the workman who consults them. This is being done more and more, and if the doctors are not too busy in serving workers of the defense industries, they will have an excellent opportunity to develop what seems to be a very practical approach to mental hygiene in industry. It is my opinion that they are doing this.

Rehabilitation. The employment of handicapped workers and the rehabilitation of disabled workers is a perennial problem in industry. While most plant physicians, with the cooperation of employment managers, supervision, and other officials, are doing a satisfactory job, methods are not yet on a scientific basis.

This is particularly important in connection with the defense program for the very obvious reason that workers are needed in defense industries. Figures released by the Selective Service System show that a rather high percentage of selectees are rejected, or accepted for limited service, because of physical conditions—some 40 per cent. True enough, many of these causes of rejection are of a minor nature and do not preclude employment in industry, but eventually many of them result in disabilities.

Therefore, it is important in developing a rehabilitation program, that industrial doctors take steps for cooperation with the medical profession in the correction of remedial impairments. It is equally important that they exercise great care in the recommendation of impaired individuals for employment. This does not necessarily imply outright rejection of large numbers of workmen or prospective workmen. It does mean careful placement.

As this function of industrial medicine is assuming importance in the national defense program, there is reason to believe that the experiences will result in a procedure that will function with justice to both workers and management.

Physical Examinations. Because of the spread of interest in industrial health and the consequent recognition of its importance by management and workers, as well as by the medical profession in general, the examination of applicants for employment and the re-examination of employees is assuming a better status.

In the first place, its importance is being recognized. In the second place, the value of more complete examinations is becoming apparent. Medical departments in industry are being equipped with x-ray apparatus for chest work, facilities for serological tests, and in some instances, for electrocardiographic studies, metabolism studies, etc. In short, the standard of the physical examination is rapidly rising.

Incidentally, this is symbolic of the status of industrial medicine. The general profession is coming to recognize it as an honorable and important specialty in medicine.

Women in Industry. Women are gradually displacing men in the defense industries. That happened in the World War and it is

already happening in this emergency. Fifty per cent of the manufacturing in England today is done by women. They work in tool rooms, operate cranes and electric trucks and various other types of machinery. They have become so skillful on these jobs that they are often more efficient than men were. In Canada, they are running trucks and operating gas stations and taxicabs.

I am not prepared to discuss the wisdom of this practice, but as a physician, I am prepared to offer a word of advice. Sickness absenteeism among women in industry is very high, a daily absence of 10 per cent is not unusual. Their annual rate exceeds that of the men by approximately 200 per cent and their disability periods by more than 10 days. They must be thoroughly examined before employment, which is not common practice, carefully placed, and have conscientious physical supervision. If this is done, their rate of sickness absenteeism can be brought down somewhat—but it is still very high.

Working Environments. Thus far, the medical aspects of industrial health only have been considered. There are others of sufficient importance to mention, notably, general ventilation, heating, lighting, and other environmental conditions, all of which bear importantly on health.

Fortunately, industry is progressing just as rapidly and as soundly in respect to these as it is in the purely medical field and, incidentally, this progress is comparable with the progress in manufacturing methods.

Effective Industrial Health Education

By DR. J. J. BRANDABUR

Assistant Supervising Surgeon, Chesapeake & Ohio Railway Company, Huntington, W. Va.

One of the greatest problems of any industrial health unit is how to reach the groups for whom certain preventive measures are necessary and how they will be most effective. I shall attempt to show what measures we feel have been effective in the education of the employees in our organization, namely—through the medium of the pre-employment and periodic physical examination, with a follow-up by his family physician. By this means there is a direct person-to-person relationship which is so necessary in order to make the public appreciate the value of good health so that it will accomplish the most good and the patient will feel that he has not been misdirected because he has confidence in his family physician.

Briefly, health education is best accomplished by informing the employee or the public with relation to matters of health and so to interest and motivate them that the results of our labors will be a change in conduct toward an ideal which we hope to attain. The primary object of all education is not only to inform but to influence an individual. For example: it does not good for an individual to know that he has an abnormal heart condition if he is not influenced by his family physician to conserve his energy by changing his habits of living or work so that he will not be a hazard to himself or his fellow employees. The average individual has a tendency to change back to old habits as soon as he begins to feel well, therefore the periodic physical examination is a constant reminder or check rein on him.

In the matter of the pre-employment examination, which some industries term placement examinations because the idea behind them is not to reject those with physical defects, but to place men at work for which they are physically fit. Those who are rejected are turned down simply because their particular defect makes them a hazard, therefore unsafe in that particular type of employment either to themselves, to their fellow employees or to the general public. Very few of us who are perfect human specimens from a physical standard, therefore industry must of necessity accept its share of less than perfect applicants and teach them to become perfectly useful employees.

Naturally, therefore, you are interested in what means we use to make industrial health education effective. Because our system extends over a vast area we cannot have full

time men; therefore like most small industries our examinations must be made by competent medical men located anywhere along our right of way. The report of the examination is sent to our office and on review of the report the applicant is accepted or rejected. If he has a minor defect we may qualify him temporarily and send a letter to him notifying him about his defect and asking that he place himself under the care of his family physician and to be sure that he does this we request some type of answer from the physician whom he has consulted.

In case he has a major defect which is remedial, if he is sufficiently interested he is notified regarding this defect and told to have it corrected and we might then be able to qualify him if he can come up to our standards:

Example of Case

An applicant was examined Jan. 17th, 1941, at which time it was found he had a hernia, he was notified regarding the defect which caused his temporary disqualification and had the condition corrected and was re-examined and qualified as soon as his condition permitted.

In many cases we have found that this was the first examination these men had, and they had thought themselves to be in perfect health and were thankful for the defect having been discovered. This matter of sending them a letter is more productive of good results than merely telling the applicant he has a defect and taking a chance that he will present himself to his physician, because he merely has to present his letter to his physician, and it is not necessary for the physician to do any guess work as regards his defects. In this way also he retains that personal contact with his family physician in whom he has utmost confidence and learns to know that the particular industry is anxious to accept him if he is a good physical risk and not a hazard and it gives an opportunity for the physician to explain how important it is to be in good health in order to be most beneficial to himself, his family and the industry he represents.

That the examination has its safety features from the standpoint of our industry might well be noted from the accompanying chart:

REJECTION OF APPLICANTS

Causes	No.
Defective vision	158
Abnormal Blood Pressure	88
Abnormal Heart	85
Hernias	52
Diabetes potential	29
Nephritis	24
Color Blind	19
Luetic	15
Defective hearing	10
Gonorrhea	10
Tuberculosis	5
Skull injuries	5
Deformities in extremities	4
Thyroid	3
	Total 507

From 1934 up to Jan. 1941 out of 6,104 applicants 507 were rejected.

The primary point I wish to bring out here is the fact that the majority of these individuals never knew they had anything wrong with them, therefore were probably making no effort to overcome the defect.

Doctor Parran stated recently that it is wasteful for industry to train a highly skilled employee over long months, only to have him break down suddenly with tuberculosis, mental disease or some crippling condition; therefore, the periodic examination at stated intervals or examinations made at the request of the employee or his supervisory officer are likewise of great value, in that they contribute to the health and efficiency of workers in several ways.

1st. Employees exposed to hazardous conditions due to their type of work may contract some occupational disease or due to an aging process develop a condition which makes them unsafe to the public, themselves or their fellow employees.

2nd Employees showing evidence of occupational disease can thus be removed from exposure and appropriately treated and at the same time necessary steps made to control the occupational hazard.

The inclusion of the executive personnel is beneficial from two standpoints:

a . . . You are prolonging the life and efficiency of men who are harder to replace;

Defects	1934		1938	
	No.	%	No.	%
Overweight	277	13.1	116	5.5
Teeth (Pyorrhea, Dead teeth)	317	15.0	162	7.6
Tonsils	83	4.0	10	0.5
Glycosuria	33	1.5	33	1.5
Albumin	139	6.6	32	1.5
Hernia	79	3.7	30	1.4
Abnormal Heart	99	4.7	78	3.7
Blood Pressure (above normal)	421	20.0	268	12.6

This chart represents the results in a group consisting of approximately 2200 men.

b . . . It has a psychological effect of selling the benefits of the examinations to the other employees, therefore, aids in proving that the measure is not discriminatory. In this regard it should be stated that the records must be a matter of strict confidence between the members of the medical department. All that is necessary for the supervisory officer to know is whether the employee is safe for his particular work.

These are precisely the ideals followed in our methods of carrying on the periodic physical examinations.

The examination is carried out by one of our examining surgeons along the nearest terminal point. The history form constitutes direct questions regarding any illnesses, injuries or operations. The physical examination proper covers all systems of the body. In this way most of the chronic illnesses are detected that rank high as the causes of death among industrial workers. Unfortunately this type of examination does not always exclude some conditions which may produce sudden death—for example—such as may happen in coronary heart disease and for this reason some people are apt to frown on the results of these examinations, but these are rare conditions. How often have you taken your automobile to be checked before starting on a trip and then have some breakdown develop which was not anticipated.

In an effort to avoid this type of emergency after the report of the employee's examination is reviewed in our office a letter is sent to the employee even on the slightest defect.

If his condition warrants it we may request an examination more frequently.

Since industrial hygiene is not limited to the prevention of occupational diseases, but also seeks to promote the health and prolong the life of the worker we are attempting to educate the employee to realize that good health is an economic investment to himself —for instance—the man in poor physical condition is neither likely to do good work and therefore fails to merit promotion, either because he does not get along with other employees or because he is indifferent, temperamental, tactless or dissatisfied. It is difficult to evaluate just how effective any program of health education is because we have no measuring stick as it were to note our progress in the matter of efficiency or benefits accruing to the individual. However, in the middle years of life modifications in our mode of living and working are exacted by the laws of nature. But being human beings most of us believe that nature will not take its toll on us and we all carry on with increasing activity until some vital structure fails leaving some of us invalided if we are left to our own. Nature has endowed us with a physical reserve which enables us to carry on in the presence of the early stages of disease. For this reason defects have not been discovered until they have advanced beyond the possibilities of relief in this way producing man failure possibly at a critical moment. The periodic physical examinations are primarily for the purpose of discovering these defects in the early stages, when there is a possibility of cure or amelioration of the condition so that the progress of any degenerative conditions delayed and the safety factor is thus augmented as well as the economic activity prolonged.

We feel that our program has been effective if there has been an improvement along these lines particularly. The accompanying chart shows that we have effected some improvement in the health of our employees therefore the periodic examination is an effective method of industrial health education.

Essentials of Healthful Industrial Environment

By MYRON A. SNELL

Supervising Engineer, Hartford Accident & Indemnity Co., Hartford, Conn.

In 1940 occupational accidents were responsible for 17,000 killed, 16,000 permanently disabled, and 1,350,000 temporarily disabled.

Although the recognized diseases of occupation are responsible for only a comparatively small proportion of these industrial injuries, many other factors in industrial environment are partly responsible for them. The personal habits of the individual as well as the nature of his home environment must also be charged with their share of this responsibility.

It is known that the incidence of the common diseases of life which are not due to the occupation is higher among industrial workers than among the balance of the population. Consequently, the life expectancy of the individual employed in industry is approximately eight years less than for the non-industrial worker. There is no doubt but that considerable improvement would result through the elimination of all of the unsatisfactory conditions to which workers are exposed in industry.

The Metropolitan Life Insurance Company conducted a study which revealed that approximately 2 per cent of all workers are incapacitated all of the time on account of illness. This means that the estimated 50 million workers in the United States lose four hundred million days annually on account of injury and illness, resulting in an average direct loss of wages at $5.00 per day of two billion dollars.

The Air Hygiene Foundation of America are engaged in a study of "Sick Absenteeism in Industry." Their records show that more than eight days are lost per male wage earner per year and more than twelve days per female wage earner per year because of sickness. A considerable proportion of this cost is assumed by the employer through lower production and poorer earnings.

Many companies have already discovered that a large proportion of the employees with poor health records also had poor safety records. These employers are spending money to improve the health of the employees through the elimination of unhealthful conditions at home as well as on the job. They receive a large return on the investment, not only through the reduction of time lost from the job through sickness but also from the reduction in the cost of industrial accidents and diseases.

Industrial Health

Although progressive employers recognize the importance to them of healthy, satisfied employees, it is unfair and unjust to impose upon them the legal liability for any illnesses or diseases among the employees that are not actually caused by the employment. Occupational disease laws should be carefully enacted and justly administered so that the employer will not be expected to provide general health insurance for his employees. The industrial environment is actually responsible for only a small proportion of the time lost from the job by employees.

Every employer should, of course, be required to provide his employees with a safe and healthful place in which to work. Such an environment can be achieved only through a study of every condition of industrial life followed by an adjustment of these conditions to the health requirements of the industrial worker.

Atmospheric Contaminants

Employees should not be subjected to the inhalation of atmospheric contaminants in sufficient concentrations to cause disease or poisoning, nor even in concentrations sufficient to cause any marked degree of discomfort. Polluted air is undesirable even though the foreign material in the air is not present in harmful quantities. Workers who are satisfied and contented with the working environment are not only happier and more efficient but healthier as well. Many individuals imagine all sorts of ill effects even from trivial industrial exposures, and may even worry themselves into an actual case of illness which was not caused by the environment but from the mental attitude of the worker.

Atmospheric contaminants in industrial plants may consist of solid dispersoids, liquid dispersoids or gases or vapors. Solid dispersoids may be divided into dusts, fumes and smokes. Liquid dispersoids may be divided into mists and fogs.

Dusts

Industrial dusts are mechanically generated by many different processes and operations. Typical examples are drilling, blasting and crushing in mining and quarrying; polishing, buffing and grinding in metal finishing and stonecutting, polishing and abrasive blasting in the granite and monument industry. The dust generated in every case is of the inorganic or mineral variety. Animal and vegetable dusts are known as organic dusts and are generated by such operations as the processing of cotton, the working of wood, or the polishing of skins.

From the health standpoint, industrial dusts of above ten microns in size are of no importance because they are too large to be inhaled into the lungs themselves. Dusts below ten microns in size are not visible to the naked eye but can be seen with a microscope down to about two-tenths of a micron in size. Dusts containing sufficient percentages of free silica and asbestos may cause diseases known as silicosis and asbestosis if inhaled in sizes below ten microns in sufficiently high concentrations over a great enough period of time. Other dusts, with the exception of the metallic dusts, do not result in diseases, but many of them do result in certain changes in the lungs which are evidently not of great importance. Nevertheless, workers should not be allowed to inhale high concentrations of any kind of dust, regardless of its composition.

Permissible limits or maximum allowable concentrations for these dusts have been established by various organizations, but as yet there has been no complete agreement for dust concentrations in workroom atmospheres. The American Standard Safety Code for the Protection of Heads, Eyes and Respiratory Organs recommends "that no worker be continuously subjected without a protector to an atmosphere containing any form of mineral dust in quantity exceeding 50 million particles per cubic foot of a size less than 10 microns." The National Silicosis Conference in 1937 suggested that the maximum permissible concentration should be found by multiplying the percentage of free silica by the total dust count. If the result is under five million, the condition may be considered permissible. If the result is over five million, the condition may be considered too high.

California, Connecticut and some other states allow no more than five million particles of dust running high in free silica. New York State, in the Industrial Code adopted September 1, 1941, for the control of silica dust in the stonecutting and stone finishing industry, allow five million particles if the dust contains more than 70 per cent free silica, 10 million particles if it contains from 10 to 70 per cent, and 100 million particles if it contains less than 10 per cent free silica. The State of California has established a permissible limit of 5 million particles per cubic foot of air for asbestos dust.

Metallic dusts may also be generated mechanically in such operations as weighing and mixing red lead and litharge in the manufacture of paints or storage batteries. The permissible limits for such toxic dusts are the same as for the fumes of these metals.

Fumes and Smokes

Inhalation of the freshly formed fume of any metal in sufficient concentrations may cause the condition known as "metal fume fever," also known as zinc chills or shakes. Although this condition causes a great deal of discomfort and may be alarming to those who are not familiar with it, it is actually not a disease and has no permanent effect on the individual. The inhalation of the dusts or fumes of the toxic metals can also cause systemic poisoning if inhaled in sufficient quantities.

As yet there are no definite standards established for most of the toxic metals. The American Standards Association's Sectional Committee on Allowable Concentrations of Toxic Dusts and Gases is developing standards for cadmium, chromium, lead and mercury. They also propose to develop standards for antimony, arsenic, manganese and zinc. All of these standards will probably be available in the near future.

The Journal of Industrial Hygiene and Toxicology in the June, 1940, issue published

a "Code for Safe Concentrations of Certain Common Toxic Substances Used in Industry." This code was prepared by a group of five expert industrial hygienists and contained a list of suggested permissible limits to be used as a guide until the time that the American Standards Association's committee had completed the standards for the substances mentioned. The maximum allowable concentrations for certain of the toxic metals were as follows: Cadmium 0.1 mg. per cu. meter; Chromium 0.1 mg. per cu. meter; Lead 0.15 mg. per cu. meter; Mercury 0.1 mg. per cu. meter, and Zinc 15.0 mg. per cu. meter.

Very little work has been done on maximum concentrations of smoke which can be tolerated without impairing efficiency or causing marked discomfort, and no limits have as yet been established.

Mists and Fogs

Mists are formed by the mechanical disintegration of a liquid by such processes as spray coating of paints or vitreous enamels. They usually range in size from about 50 to 100 microns.

Fogs are formed by the condensation of vapors. They vary in size from 5 to about 50 microns. Wherever hot alkaline cleaning or pickling vats are operated in a workroom in which the temperature is quite cool, the water vapor is apt to condense in the form of a fog in the room in the same manner that ordinary fog is formed in the outdoors. A mist which may be inhaled in spray coating operations may be rather complex in nature. In the case of spraying paints, it usually consists of a mixture of organic solvents of a varying degree of toxicity together with solid matter in solution or in suspension. These fine droplets in the form of mist may hold in suspension lead oxide as a pigment or other particulate matter of a toxic nature. In the spray coating of vitreous enamels a water vehicle is used but the particulate matter in suspension may contain toxic metals in the form of oxides such as cadmium, lead and manganese. In addition, they sometimes contain finely divided particles of free silica in the form of quartz or flint.

The maximum allowable concentration in inspired air containing mist is the same as that for the vapors, fumes or dusts of the substances contained in the mist.

Vapors and Gases

While vapors are composed of the gaseous phase of substances which usually exist in the form of liquids under ordinary conditions, gases exist only in the gaseous state under ordinary conditions.

Vapors and gases are frequently but incorrectly termed "fumes." For example, "nitrous fumes" instead of nitrogen oxide gases. A liquid organic solvent such as carbon tetrachloride will evaporate from an open tank in a workroom and the vapors of carbon tetrachloride collect in the surrounding atmosphere. Thus the carbon tetrachloride can exist under the ordinary conditions of the workroom either as a liquid or a vapor. On the other hand, the oxygen and carbon dioxide gases in the air of the workroom cannot exist under such normal conditions in any other state.

There are a vast number of organic solvents in use in industry and the number is increasing each year through the discovery of new and better solvents in the industrial chemical laboratories. The extent of damage to the health of workers through the inhalation of the vapors of many of these solvents is not known.

American standards have been established this year for benzol of 100 parts per million parts of air, carbon disulfide 20 parts per million, carbon monoxide 100 parts per million and hydrogen sulfide 20 parts per million. The American Standards Association's Committee on Allowable Concentrations are at present engaged in the development of standards for acetone, carbon tetrachloride, diethyl ether, formaldehyde, hydrofluoric acid, methanol, nitrous gases, tetrachlorethane, tetrachlorethylene, toluol, trichlorethylene and xylol. Tentative suggested standards for these as well as for about 23 additional gases and vapors are given in the June, 1940, issue of the Journal of Industrial Hygiene and Toxicology, as already mentioned.

Atmospheric Pollution

The only definite method of determining whether or not a concentration of atmospheric contaminants exists in the workroom that constitutes a health hazard is by means of collection and analysis of air samples.

These atmospheric pollution studies require the services of trained industrial hygienists and the use of proper field and laboratory equipment. Many private companies as well as individuals are equipped to do this work for themselves or for others.

In addition, there are at the present time 31 industrial hygiene units located in that many different states, who are prepared to do this work for industrial concerns at their request. In all but New York and Massachusetts these units are operated by State Departments of Health in cooperation with U. S. Public Health Service. In addition to supplying the plant owner with an analysis of the health hazards in this plant, these units make invaluable suggestions for their correction or elimination through the use of proper engineering control methods.

Ingestion of Toxic Substances

The vast majority of cases of industrial poisoning occur through inhalation of the toxic substances rather than by ingestion or by absorption through skin, for two reasons. In the first place, the principal exposure to toxic substances in industry is through inhalation and not ingestion or absorption. In the second place, in those few cases where poisonous substances are swallowed, they are almost entirely eliminated through the alimentary tract without being absorbed into the bloodstream and a large percentage of the small amount absorbed into the bloodstream is further eliminated through the liver. Consequently very little of the ingested poison gets into the general circulation to cause damage to the vital organs.

In the case of an employee who is working with lead oxide in the manufacture of storage battery plates, he is inhaling any dust which may contaminate the working area at the rate of 16 times each minute during the entire day. On the other hand, he usually eats but once a day on the job. In addition he may swallow at other times during the day an amount of lead which in itself could not cause poisoning.

Skin Contact

A few of the organic liquids such as tetraethyl lead used in leaded gasoline and benzol may cause poisoning by absorption through the skin. Such cases, however, are comparatively rare and most of the known toxic substances do not readily enter the bloodstream by skin absorption.

Approximately two-thirds of all occupational disease claims, however, are for dermatitis and other skin affections. Industrial employees come in contact with a considerable number of substances which invariably result in the development of a dermatitis condition. In addition, there are a great many other substances used in industry which cause abnormal skin conditions to develop in certain few individuals but not in others. This highly specialized subject has been given a great deal of attention in recent years and much information has been published about it.

There are two methods of prevention available. The first involves the use of skin tests to determine individual reaction to substances which are generally known to cause dermatitis. This is done before employment in the exposure, and employees who show a positive reaction are placed in other jobs.

The second method consists of preventing contact between the individual and the harmful substance through complete enclosure, exhaust ventilation, the use of rubber gloves or other protective clothing, or protective skin cream. Personal cleanliness also is an extremely important factor in the prevention of industrial dermatitis.

Infectious Diseases

A considerable number of industrial cases of anthrax, glanders, undulant fever and tularemia are reported every year. These diseases of animals are invariably contracted by man through ignorance or negligence on the part of the employees or their supervisors. Industrially they are easily contracted through contacts with infected hair or hides or the diseased animals themselves. Practically every such case could have been prevented either through sterilization of the animal parts themselves or through the use of protective clothing on the part of the employees.

Miscellaneous Diseases

There are miscellaneous conditions to which industrial workers may be exposed which are responsible for a considerable number of actual cases of disease. *Com-*

pressed air illness or caisson disease results from too rapid decompression after working under pressures greater than one atmosphere. Time and pressure tables have been established for maximum rates of compression and decompression which should be followed in all cases. In some states this is required by law.

Radiant energy when used in industry may result in serious consequences if adequate safety precautions are not taken. Workers should not be exposed to harmful amounts of radioactive substances or X-rays. In every case the protective measures published by the National Bureau of Standards should be religiously followed.

Both ultra-violet and infra-red rays have certain beneficial effects on human beings if they are absorbed by the body in moderate amounts. Light rays produced industrially, however, may have a serious effect upon the health of workers if proper personal protection is not provided. Cataract may result from exposure to the heat and glare of molten glass. Serious eye and skin burns may result from undue exposure to the bright arc produced in electric welding. The use of goggles with properly colored lenses, face shields, gloves, and proper clothing afford adequate protection.

Pressure, Motion and Shock

Synovitis, or tenosynvitis, or bursitis, or cellulitis of any of the joints of the body may result from any occupation involving continual or repeated trauma, vibration, pressure or friction. Examples are the diseases suffered by workers who spend many years in handling pneumatic tools used in such operations as riveting and drilling. If possible the employees of concerns engaged in such operations should be rotated so that no one individual is exposed to the harmful effects of conditions such as these for long periods of time.

Temperature and Humidity

The average comfort zone in the wintertime is from 63 to 71° E. T. (Effective Temperature). 66° E. T. is the most popular effective temperature as adopted by the American Society of Heating and Ventilating Engineers for individuals at rest wearing customary winter clothes living in the broad geographical belts across the United States in which heating of the convection type is generally used during four to eight months of the year. It doesn't apply to rooms heated by radiant energy, rooms with excessive glass area or those with poorly insulated or cold walls. In densely occupied spaces somewhat lower temperatures may be necessary. Satisfactory comfort conditions for men at work have been found to vary from 40 to 70° E. T. depending on the rate of work and the amount of clothing worn. In hot industries 80° E. T. is considered the upper limit compatible with efficiency and whenever possible this should be reduced to 70° E. T. or less.

In the summertime the average comfort zone is from 66 to 75° E. T. with 71° E. T. as the popular average. This is 4 to 5° higher average than in the wintertime.

The temperature differential between indoors and outdoors which should be maintained depends on a number of factors. A drop in temperature of 10° F. or more may be extremely harmful if it occurred suddenly, especially when the skin and clothing are wet with perspiration.

No standard has been established for the proper amount of humidity. It may vary from 30 to 70 per cent without discomfort. The air should be dry rather than damp. The common belief that dry air in itself exerts a harmful effect on the skin and mucous membranes has never been proved by convincing evidence, although there have been numerous investigations on the subject. The addition of moisture to the air of occupied rooms by any practical method has not been shown to have any beneficial effect upon health and comfort. Experiments have shown that the respiratory membranes of industrial workers exposed to hot, *moist* air are distinctly more abnormal than those of workers exposed to hot, *dry* air.

The maximum air movement should be 50 feet per minute with not less than 10 cubic feet per minute per occupant of the room taken from an outdoor source. Mr. Yaglow states that "an air movement of not over 40 f.p.m. is permissible under present engineering practice, when the temperature of the air current is 2° F. or less below ordinary room temperature. Current velocities as high as 200 f.p.m. may prove desirable

in hot industries, but velocities much higher than this are uncomfortable and irritating and may blow dust off the floor."

Work in the hot industries may be responsible for a number of physiological derangements, the best known of which is heat exhaustion or heat cramps. The conscientious use of salt tablets by the employees in such industries has largely eliminated the disability and discomfort which were prevalent a few years ago.

Since the amount of rise in body temperature of employees in hot atmospheres has been shown to indicate disturbances in physiological equilibrium, the American Society of Heating and Ventilating Engineers has suggested an average "temperature rise of one-half degree in the average worker qualified by physical makeup and experience to work in hot industries, or a one- and one-half degree rise in an occasional worker" as the limiting factor.

The A.S.H.V.E. state that "the thermal environment cannot be properly adjusted to the requirements of human health and comfort without control of all the four basic factors concerned—temperature (true air temperature free from radiation effects) movement of the air, humidity of the air, and mean radiant temperature of the surrounding surfaces." Their research laboratories are at the present time engaged in a research program with the aim of establishing minimum requirements for air conditioning for industries which would be acceptable to everyone concerned.

Miscellaneous Conditions

Abnormal noise levels have a profound effect upon industrial workers and may result in deafness or other pathological ear conditions. The A.S.H.V.E. 1941 Guide contains a table giving the acceptable noise levels under various conditions. These noise levels vary from 10 to 100 decibels depending on the source and location. Dr. Knudsen reported that "long exposure to sounds above a level of 80 to 90 decibels or a brief exposure to more intense noises invariably impairs hearing. Other results are vestibular disturbances, mental fatigue, loss of efficiency, and extreme nervousness which can be traced to excessive noise. Some persons are more susceptible to excessive noise than others, but no one is immune to long continued intense sound. Noise has become more than a nuisance—it is a menace impairing the hearing of millions, robbing them of quiet leisure, restful sleep and taking a toll of the general nervous system of mental workers, neurotics, hospital patients and others who are noise sensitive." Noise reduction at the source may be accomplished by insulation, absorption or by reducing the noise from machinery and equipment. Most employees object to wearing ear stoppers but Dr. Knudsen has devised an ear defender providing an insulation of 35 to 40 decibels which is very effective.

Tobacco Smoke and Body Odors, with the exception of toxic atmospheric contaminants, are the principal factors to be considered relative to comfort and efficiency. Such odors are not harmful but nevertheless have a profound effect on individuals. In the same manner other disagreeable odors adversely affect the efficiency of workers.

The amount of outdoor air needed for body odors should be somewhere between 10 and 30 c.f.m. per person depending on age, socioeconomic status, air space in cubic foot per person, outside and inside temperatures and humidity. The minimum air change requirements for tobacco smoke has not yet been definitely determined but probably should be in the neighborhood of 5 to 15 c.f.m. per person. These air requirements are in addition to those needed for indoor recirculation in order to maintain the humidity and temperature at the proper levels.

Space Allotments for industrial workers are of questionable value and minimum requirements for them cannot be given at the present time because this factor is so closely associated with many others, principally that of the ventilation problem.

Illumination of the proper intensity for the type of work to be performed should be provided for all industrial workers. The equipment providing illumination should be of the proper type and installed so as to give maximum efficiency with a minimum amount of glare, eyestrain, or other adverse effects. Improper lighting may be responsible for actual diseases of the eye in addition to eyestrain and eye fatigue. Improper illumi-

nation may not only result in poor efficiency but also in a high accident frequency. The number of foot-candles for proper industrial illumination varies up to a point beyond 100. They are published in table form for various occupations in Safe Practices Pamphlet No. 22 on "Industrial Shop Lighting."

Other Factors which should be considered in the subject of industrial health are working postures, and the proper kind of floor covering. Standing or walking on concrete or other hard surfaces produce fatigue and may even be harmful to some individuals in prolonged exposures. The Gilbreth International Committee on Industrial Fatigue place great stress on the harmful effects of improper posture among industrial workers. The use of proper chairs eliminates fatigue and greatly improves efficiency.

The comfort and efficiency of industrial workers are also affected by the color scheme of the environment, the length of the working hours and the rest periods used in connection with them, the general housekeeping conditions and cleanliness of the plant, locker, washroom, sanitation and eating facilities, medical facilities, and by proper provisions for recreation. Most of these, however, have little or no important effect upon the actual health of the industrial worker.

ADJOURNMENT